NASA SBIR 2019 Phase I Solicitation

A1.02 Quiet Performance - Airframe Noise Reduction

Lead Center: LaRC

Participating Center(s): GRC, LaRC

Technology Area: TA15 Aeronautics

Innovative technologies and methods are necessary for the design and development of efficient, environmentally acceptable aircraft. In particular, the impact of aircraft noise on communities around airports is the predominant limiting factor on the growth of the nation's air transportation system. Successful reductions in aircraft noise would lead to wider community acceptance, lower airline operating costs where noise quotas and fees are employed, and increased potential for air traffic growth on a global scale.

In support of the Advanced Air Vehicles, Integrated Aviation Systems, and Transformative Aeronautics Concepts Programs, improvements in technologies and methods for noise prediction, measurement of acoustic and relevant flow field quantities on aircraft, noise propagation modeling, and noise control are needed for subsonic, transonic, and supersonic vehicles. This subtopic is seeking innovations specifically targeting airframe noise sources and noise sources due to the aerodynamic and acoustic interaction of airframe and engines.

State-of-the-art technologies for noise reduction for conventional transport aircraft are generally passive and do not incorporate advanced material systems or adaptive mechanisms that can modify their performance based on the noise state of the vehicle. Advanced material systems for airframe noise control are still in their infancy, especially in the context of robustness and being certifiable. Novel material systems that could be applied to component noise sources on the aircraft are needed, such as shape memory alloy actuators, or active or adaptive systems. In addition, future aircraft designs are envisioned that leverage noise benefits of complex geometrical configurations, such as engine integration with the airframe. However, efficient computational tools that enable rapid-turn evaluations of multiple configurations at the design stage are lacking. Numerical methods to study complex engine/airframe configurations are complex and difficult to leverage at the aircraft design stage where configuration details are not specified. Improvements to numerical methods and models for studying the noise aspects of advanced airframe configurations, including engine integration, would ease consideration of acoustics early in the design cycle, rather than leaving acoustics to the late or post design stages where noise control solutions are costly and less effective.

Therefore, this subtopic is seeking innovations in the following specific areas:

- Fundamental and applied computational fluid dynamics techniques for aeroacoustic analysis that can be adapted for design purposes.
- Prediction of aerodynamic noise sources, including those from the airframe and those that arise from significant interactions between airframe and propulsion systems (i.e., Propulsion Airframe Aeroacoustics).
- Prediction of sound propagation from the aircraft through a complex atmosphere to the ground. This should include interaction between noise sources and the airframe and its flowfield. Thus, acoustic

shielding/scattering effects should be incorporated.
- Innovative source identification techniques for airframe noise sources, such as landing gear and high lift systems. This should also include turbulence details related to flow-induced noise typical of separated flow regions, vortices, shear layers, etc.
- Concepts for active and passive control of noise sources for conventional and advanced aircraft configurations, including adaptive flow control technologies, and noise control technology and methods that are enabled by advanced aircraft configurations, which also includes integrated airframe-propulsion control methodologies. Innovative acoustic liner and porous surface concepts for the reduction of airframe noise sources and/or propulsion/airframe interaction are solicited; however, engine nacelle liner applications are specifically excluded.
- Concepts for novel acoustic calibration sources for both open- and closed-wall wind tunnel testing. Such sources should provide well-defined acoustic characteristics—both with and without flow—for typical frequency ranges of interest in scale-model wind tunnel testing for the purposes of magnitude and phase calibration for both single microphones and microphone phased arrays.
- Development of synthesis and auditory display technologies for subjective assessments of aircraft community noise.

The deliverables would be low Technology Readiness Level (TRL) - between 3-5 - technologies that demonstrate a potential for component noise reduction or demonstrate characteristics that could be incorporated into a more sophisticated noise control solution for transport aircraft.

Within the Advanced Air Vehicles Program (AAVP), the Advanced Air Transport Technology (AATT) and Commercial Supersonic Technology (CST) Projects would both benefit from noise reduction technologies that would reduce the aircraft noise footprint at landing and takeoff. Configurations with novel engine placement, such as above the fuselage, can reduce the noise footprint, but technologies are needed to efficiently model the performance and noise impacts of these novel engine locations.

Within the Transformative Aeronautics Concepts Program (TACP), the Transformational Tools and Technologies (TTT) Project would benefit from tool developments to enhance the ability to consider acoustics earlier in the aircraft design process. The TTT project would also benefit from development and demonstration of simple material systems, such as advanced liner concepts with reduced drag or adaptive structures that reduce noise, as these component technologies could have application in numerous vehicle classes in the AAVP portfolio, including subsonic and supersonic transports, as well as vertical lift vehicles.

References:

- AATT: https://www.nasa.gov/aeroresearch/programs/aavp/aatt
- CST: https://www.nasa.gov/aeroresearch/programs/aavp/cst
- TTT: https://www.nasa.gov/aeroresearch/programs/tacp/ttt